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Title: Updating the Godiva-IV Benchmark

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Updating the Godiva-IV Benchmark

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LA-UR-XXXXXX

Summer Fun – Camping in Moab, Utah

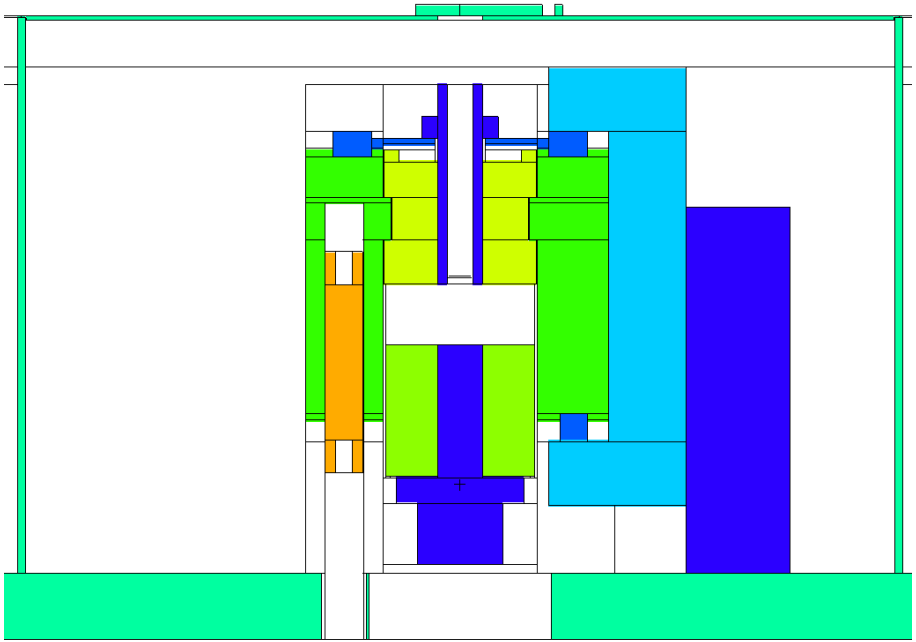
Victoria Hagopian (Group NEN-2)

- Educational Background
  - BS North Carolina State University, 2017
  - PhD Penn State University, 2022

- Division
  - Group: NEN-2
  - Mentors: Joetta Goda, Jesson Hutchinson, Geordie McKenzie

- Research
  - Updating Godiva-IV benchmark
  - Critical and subcritical experiments

Research Overview and Motivation



- **From the disassembly…**
  - Updated spindle dimensions
  - Updated glory-hole dimensions
  - Addition of shim
- **New top hat**
- **New cross-section libraries**
  - Comparison between ENDF/B-VII.1 and ENDF/B-VIII.0
- **TR Cards**

Research Approach

```
c ~~~~~~~~ Translation Cards ~~~~~~~~
c To move the Safety Block to one of the Control System positions, change the z value of TR1 to a value of the line:
c     y = -2.54*x-0.4207
c Where y is the z value in TR1 in MCNP and x is the Control System Position in inches.
c Equation is bounded between -0.150 and 7.844 inches.
TR1 0 0 0
c
c To move Control Rod 1 to one of the Control System positions, change the z value of TR2 to a value of the line:
c     y = -2.54*x+0.8204
c Where y is the z value in TR2 in MCNP and x is the Control System Position in inches.
c Equation is bounded between -0.160 and 4.000 inches.
TR2 0 0 0
c
c To move Control Rod 2 to one of the Control System positions, change the z value of TR3 to a value of the line:
c     y = -2.54*x+0.3175
c Where y is the z value in TR3 in MCNP and x is the Control System Position in inches.
c Equation is bounded between -0.250 and 4.000 inches.
TR3 0 0 0
c
c To move the Burst Rod to one of the Control System positions, change the z value of TR4 to:
c
c Control System Position | z Value of TR4
c         Full-In         |     7.51050
c         Full-Out        |     0.00000
TR4 0 0 0
c
```

Summary of Results – ENDF/B-VII.1 vs ENDF/B-VIII.0

ENDF/B-VII.1 Cross Section Results

Case: Top Hat	Present	Removed
k_{eff}	0.99810 ± 0.00027	0.99710 ± 0.00026
Average Energy of Neutrons Causing Fission $(\mathbf{MeV})$	1.4251	1.4268
Average Number of Neutrons Produced per Fission $(\bar{\nu})$	2.595	2.595
Percentage of Fission Caused by Neutrons		
Thermal$(< \mathbf{0.625\ eV})$	0.00%	0.00%
Intermediate $(\mathbf{0.625\ eV - 100\ keV})$	5.54%	5.50%
Fast $(> \mathbf{100\ keV})$	94.46%	94.50%

ENDF/B-VIII.0 Cross Section Results

Case: Top Hat	Present	Removed
k_{eff}	0.99773 ± 0.00028	0.99633 ± 0.00026
Average Energy of Neutrons Causing Fission $(\mathbf{MeV})$	1.4227	1.4243
Average Number of Neutrons Produced per Fission $(\bar{\nu})$	2.592	2.592
Percentage of Fission Caused by Neutrons		
Thermal$(< \mathbf{0.625\ eV})$	0.00%	0.00%
Intermediate $(\mathbf{0.625\ eV - 100\ keV})$	5.04%	5.01%
Fast $(> \mathbf{100\ keV})$	94.96%	94.99%

Summary of Results – Benchmark Case 4

Benchmark Case 4 Results

Model:	Case 4
k_{eff} - ENDF/B-VI	0.9897 ± 0.0003
k_{eff} - ENDF/B-VII.1	0.9907 ± 0.0003
Average Number of Neutrons Produced per Fission ($\bar{\nu}$)	2.593
Percentage of Fission Caused by Neutrons	
Thermal(< 0.625 eV)	0.00%
Intermediate (0.625 eV $-$ 100 keV)	5.57%
Fast ($>$ 100 keV)	94.43%